

This listing of claims will replace all prior versions, and listings, of claims in the application.

**Listing of Claims:**

1 - 94. (Cancelled).

95. (Currently amended) A quantum dot, comprising:

a nanocrystalline core exhibiting quantum confinement and having a band gap;

a luminescence promoter linked to the surface of the nanocrystalline core, the luminescence promoter comprising a mercapto triethylene glycol group that does not have an associated charge in solution.

~~a non-zinc linking group;~~

~~an ethylene glycol unit linked to the surface of the nanocrystalline core through the linking group; and~~

~~the luminescence promoter selected from the group consisting of an ethylene glycol unit, an alkylthio acid, mercaptoacetic acid, and any combination.~~

96-97. (Cancelled)

98. (Previously Presented) The quantum dot of claim 95, wherein the nanocrystalline core comprises cadmium telluride.

99. (Withdrawn) A quantum dot, comprising:

a nanocrystalline core exhibiting quantum confinement and having a band gap;

a luminescence promoter linked to the surface of the nanocrystalline core; and

a biofunctional group linked to the surface of the nanocrystalline core,

wherein the luminescence promoter does not comprise a mercaptoalkanoic acid.

100. (Withdrawn) A quantum dot, comprising:

a nanocrystalline core exhibiting quantum confinement and having a band gap;

a luminescence promoter linked to the surface of the nanocrystalline core;

a non-zinc linking group; and  
a biofunctional group linked to the surface of the nanocrystalline core through the linking group,

wherein the luminescence promoter is selected from the group consisting of an ethylene glycol unit, an alkylthio acid, mercaptoacetic acid, and any combination.

101. (Withdrawn) The quantum dot of claim 100, wherein the quantum dot is stable in aqueous solution under storage in the dark at 4 °C for at least 4 months with respect to luminescence, precipitation, flocculation, and leaching of the biofunctional group.

102. (Withdrawn) The quantum dot of claim 100,  
wherein the luminescence promoter is a mercaptoalkanoic acid,  
wherein the mercaptoalkanoic acid is not linked to the surface of the nanocrystalline core through a zinc atom, and  
wherein the biofunctional group is not linked to the surface of the nanocrystalline core through a zinc atom.

103. (Withdrawn) The quantum dot of claim 100, wherein  
the luminescence promoter is mercaptoalkanoic acid,  
the mercaptoalkanoic acid is not linked to the surface of the nanocrystalline core through a group VA or VIA element which is present in the nanocrystalline core, and  
the biofunctional group is not linked to the surface of the nanocrystalline core through a group VA or VIA element which is present in the nanocrystalline core.

104. (Withdrawn) The quantum dot of claim 100, wherein the luminescence promoter comprises a non-zinc linking group and an ethylene glycol unit linked to the surface of the nanocrystalline core through the linking group.

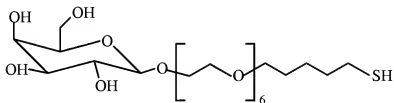
105. (Withdrawn) The quantum dot of claim 100, wherein the linking group does not comprise a

group VA or VIA element which is present in the nanocrystalline core.

106. (Withdrawn) The quantum dot of claim 100, further comprising a substantially zinc-free shell layer overcoating the nanocrystalline core.

107. (Withdrawn) The quantum dot of claim 106,  
the shell layer comprising cadmium sulfide and/or mercury sulfide; and  
the nanocrystalline core comprising a material selected from the group consisting of cadmium telluride, cadmium selenide, mercury telluride, mercury selenide, and/or any combination of these.

108. (Withdrawn) The quantum dot of claim 106,  
comprising a group of formula XXX, comprising a sulfur atom,  
wherein the sulfur atom is linked to the surface of the nanocrystalline core,  
wherein the shell layer comprises mercury sulfide, and  
wherein the nanocrystalline core comprises mercury telluride and/or mercury selenide.



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109. (Withdrawn) The quantum dot of claim 100, wherein the biofunctional group comprises at least one biofunctional unit which is not a peptide.

110. (Withdrawn) The quantum dot of claim 100, the biofunctional group comprising a biofunctional unit selected from the group consisting of a monosaccharide unit, a mononucleoside unit, a mononucleotide unit, a mono-peptide unit, a glycopeptide unit, and any

combination of these.

111. (Withdrawn) The quantum dot of claim 100, the biofunctional group comprising a biofunctional unit comprising a lipid unit and/or a glycolipid unit.

112. (Withdrawn) The quantum dot of claim 110, the biofunctional group not comprising mannose or dextran.

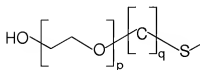
113. (Withdrawn) The quantum dot of claim 100, the biofunctional group comprising at least one tumor-associated carbohydrate.

114. (Withdrawn) The quantum dot of claim 100, wherein the biofunctional group comprises a Thomsen-Friedenreich disaccharide.

115. (Withdrawn) The quantum dot of claim 114, that selectively complexes to endothelial cells.

116. (Withdrawn) The quantum dot of claim 114, that is substantially retained by agarose-bound galactose specific peanut agglutinin and that is not substantially retained by agarose-bound mannose/glucose-specific *Pisum sativum* agglutinin.

117. (Withdrawn) The quantum dot of claim 100, comprising an ethylene glycol thiol of formula XIII comprising a sulfur atom,



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wherein the sulfur atom is linked to the surface of the nanocrystalline core, p is a positive integer, and q is an integer of at least two.

118. (Withdrawn) The quantum dot of claim 104, comprising a branched linked chain comprising the ethylene glycol unit.

119. (Withdrawn) The quantum dot of claim 100, comprising a carboxylic acid unit linked to the surface of the nanocrystalline core.

120. (Withdrawn) The quantum dot of claim 100, comprising:

an ethylene-glycol-containing linked chain; and

a biofunctional-group-containing linked chain,

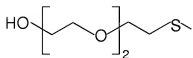
wherein the ethylene-glycol-containing linked chain does not comprise a biofunctional group and

wherein the biofunctional-group-containing linked chain does not comprise an ethylene glycol unit.

121. (Withdrawn) The quantum dot of claim 120, wherein the ethylene-glycol-containing linked chain comprises from 3 to 6 ethylene glycol units.

122. (Withdrawn) The quantum dot of claim 100, comprising:

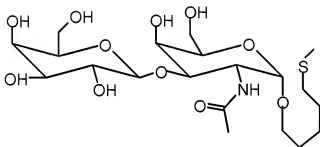
an ethylene-glycol-containing linked chain of formula XI, the sulfur atom of the ethylene-glycol-containing linked chain of formula XI linked to the surface of the nanocrystalline core; and



XI

a biofunctional-group-containing linked chain of formula XXVIIa, comprising a Thomsen-Friedenreich disaccharide as the biofunctional group and five carbon atoms and a sulfur atom,

wherein the sulfur atom of the biofunctional-group-containing linked chain of formula XXVIIa is linked to the surface of the nanocrystalline core.



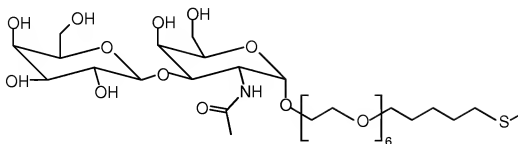
XXVIIa

123. (Withdrawn) The quantum dot of claim 100, comprising:

a biofunctional-group-containing linked chain, wherein  
an ethylene glycol unit is part of the biofunctional-group-containing linked chain and  
the biofunctional group is part of the biofunctional-group-containing linked chain.

124. (Withdrawn) The quantum dot of claim 100, further comprising

a biofunctional-group-containing linked chain of formula XXVIIb,  
comprising a Thomsen-Friedenreich disaccharide as the biofunctional group and  
comprising six ethylene glycol units, five carbon atoms, and a sulfur atom,  
wherein the sulfur atom of the biofunctional-group-containing linked chain of formula  
XXVIIb is linked to the surface of the nanocrystalline core.



XXVIIb

125. (Withdrawn) A formulation comprising:

- a liquid; and
  - the quantum dot of claim 100,
- wherein the quantum dot is dissolved or suspended in the liquid.

126. (Withdrawn) The quantum dot of claim 100, that is stable in aqueous solution under storage at room temperature in ambient lighting for at least 4 months with respect to luminescence, precipitation, and flocculation.

127. (Withdrawn) A method of imaging, comprising:

- providing the quantum dot of claim 100;
- contacting the quantum dot with a biological material;
- exposing the biological material to light having a wavelength effective to cause the quantum dot to luminesce; and
- imaging the luminescing quantum dots.

128. (Withdrawn) The method of claim 117, wherein the biofunctional group exhibits high affinity to tissue in a diseased or abnormal state, and the quantum dot luminescence images the tissue.

129. (Withdrawn) The method of claim 118, the diseased or abnormal state being cancerous.

130. (Withdrawn) A method of therapy, comprising:  
    providing the quantum dot of claim 6; and  
    contacting the quantum dot with a biological material and thereby treating a disease.
131. (Withdrawn) The method of claim 100, the biofunctional group comprising an immune-response stimulating group.
132. (Withdrawn) The method of claim 100, the biofunctional group comprising a tumor-associated antigen.
133. (Withdrawn) The method of claim 100, wherein the quantum dot further comprises a therapeutic agent linked to the surface of the nanocrystalline core.
134. (Withdrawn) The method of claim 100, wherein a shell layer and/or the nanocrystalline core comprises a therapeutic agent.
135. (Withdrawn) A quantum dot coated device, comprising the quantum dot of claim 100 linked to the surface of the device to form a coating on the device.
136. (Withdrawn) A cell-quantum dot complex, comprising:  
    a cell; and  
    the quantum dot of claim 100,  
    wherein the biofunctional group is complexed with the cell.
137. (Withdrawn) A method for producing a quantum dot, comprising:  
    providing a luminescence promoter;  
    refluxing the luminescence promoter with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution,



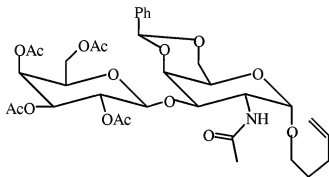
wherein the luminescence promoter is selected from the group consisting of an ethylene glycol unit, an ethylene glycol thiol, an alkylthio acid, mercaptoacetic acid, and any combination of these.

138. (Withdrawn) The method of claim 137, comprising:

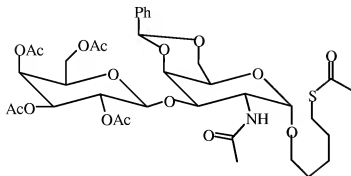
providing a biofunctional group-thiol, comprising a biofunctional unit; and  
refluxing the biofunctional group-thiol and the luminescence promoter with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution.

139. (Withdrawn) The method of claim 138, comprising:

reacting a glycoside of formula IV with an alkylthio acid in the presence of 2,2'-azobisisobutyronitrile in 1,4-dioxane at about 75° C to produce a thioester of formula V;



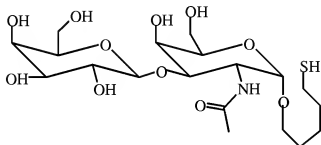
IV



V

debenzylidinating the thioester of formula V;

hydrolyzing the debenzylidinated thioester of formula V to produce a Thomsen-Friedenreich-thiol of formula VI; and



VI

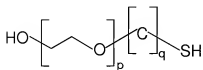
refluxing the Thomsen-Friedenreich-thiol of formula VI with cadmium perchlorate, a luminescence promoter, hydrogen sodium telluride, and a suitable solvent, to produce a Thomsen-Friedenreich-functionalized quantum dot in a solution,

wherein the suitable solvent comprises water and/or N,N-dimethylformamide.

140. (Withdrawn) The method of claim 137,

wherein the luminescence promoter comprises an ethylene glycol thiol,

wherein the ethylene glycol thiol is of formula XIII, and



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wherein p is a positive integer and q is an integer of at least two.

141. (Withdrawn) The method of claim 137,

wherein the group IIB element salt is cadmium perchlorate and

wherein the hydrogen-alkali-group VIA element compound is hydrogen sodium telluride.

142. (Withdrawn) The method of claim 137, wherein the suitable solvent comprises water and/or N,N-dimethylformamide.

143. (Withdrawn) The method of claim 138, further comprising:

reacting a glycoside of formula XVIII with an alkylthio acid in the presence of a catalyst to produce an acetylated, benzylidenated biofunctional group thiol of formula XIX;

Acetylated, Benzylidenated Biofunctional Group

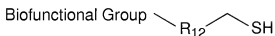
XVIII



XIX

debenzylidenating the thioester of formula XIX; and

hydrolyzing the thioester of formula XIX to produce the biofunctional group-thiol of formula XVb,

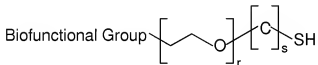


XVb

wherein  $\text{R}_{12}$  comprises a carbon atom and  $\text{R}_{13}$  comprises a carbon atom.

144. (Withdrawn) The method of claim 138,

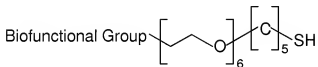
wherein the biofunctional group-thiol comprises a thiol of formula XVIb and



XVIb

wherein  $r$  is a positive integer and  $s$  is an integer of at least two.

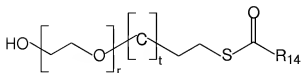
145. (Previously Presented) The method of claim 138, wherein the biofunctional group-thiol comprises a thiol of formula XVIIb.



XVIIb

146. (Withdrawn) The method of claim 138, further comprising:

reacting a compound comprising ethylene glycol of formula XXb

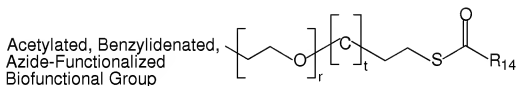


XXb

with a glycoside having azide and a group of formula XXbb as pendant groups and quenching the reaction with triethylamine to produce a compound of formula XXIIIb;

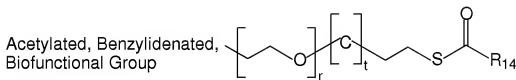


XXbb



XXIIIb

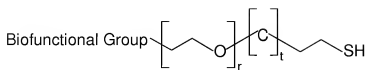
treating the compound of formula XXIIIb with acetic anhydride and a reducing agent to produce a compound of formula XXIIIc in which the azide group of formula XXIIIb is replaced with an acetamido group;



XXIIIc

debenzylidenating the compound of formula XXIIIc; and

hydrolyzing the compound of formula XXIIIc to produce the biofunctional-group thiol of formula XXIVb,



XXIVb

wherein  $r$  is a positive integer,  $t$  is zero or a positive integer, and  $R_{14}$  comprises a carbon atom.

147. (Withdrawn) The method of claim 146, wherein the group IIB element salt is cadmium perchlorate,

wherein the hydrogen-alkali-group VIA element compound is hydrogen sodium telluride,

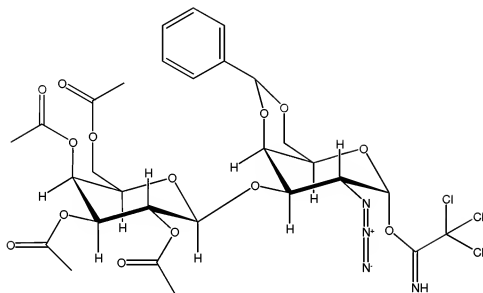
wherein  $r$  is six and  $t$  is three,

wherein  $R_{14}$  is methyl,

wherein the glycoside having an azide and a group of formula XXbb as pendant groups has formula XXII,



XXbb



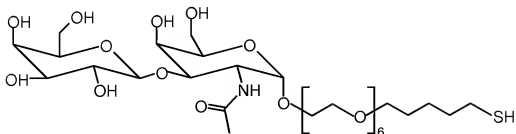
XXII

wherein the reducing agent is zinc,

wherein the debenzylidenating comprises treatment with acetyl chloride and quenching with pyridine;

wherein the hydrolyzing comprises treatment with sodium methoxide and quenching with ion-exchange resin, and

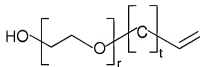
wherein the biofunctional-group thiol is of formula XXIVc.



XXIVc

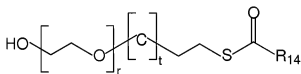
148. (Withdrawn) The method of claim 146, further comprising:

reacting a polyethylene glycol with sodium hydroxide and a brominated alkene to produce a compound of formula XXa; and



XXa

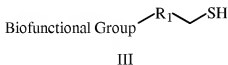
reacting the compound of formula XXa with an alkylthio acid in the presence of a catalyst to produce a compound of formula XXb,



XXb

wherein *r* is a positive integer, *t* is zero or a positive integer, and R<sub>14</sub> comprises a carbon atom.

149. (Withdrawn) The method of claim 142, comprising refluxing the biofunctional group-thiol of formula III with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution,



III

wherein R<sub>1</sub> comprises a carbon atom and/or an ethylene glycol unit,  
wherein the group IIB element comprises cadmium and/or mercury, and  
wherein the group VIA element comprises tellurium and/or selenium.

150. (New) The quantum dot of claim 95, wherein the mercapto triethylene glycol group

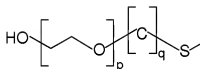


comprises mTEG, or is derived from mTEG-SH reacted with the nanocrystalline core, or both.

151. (New) The quantum dot of claim 95, further comprising a biofunctional group linked to the nanocrystalline core through a linking group.

152. (New) The quantum dot of claim 151, wherein the biofunctional group comprises Thomsen-Friedenreich disaccharide.

153. (New) The quantum dot of claim 151, wherein the linking group comprises an ethylene glycol thiol of formula XIII comprising a sulfur atom,



XIII

wherein the sulfur atom is linked to the surface of the nanocrystalline core, p is a positive integer from 3 to 6, and q is an integer of at least two.

154. (New) The quantum dot of claim 153, wherein p is 6 and q is 5.

155. (New) The quantum dot of claim 95, wherein the luminescence promoter comprises a plurality of groups of the formula

